

Opportunities and Challenges: The Financial Impact of Net-Metering on the Mexico Area Branch Office of Pampanga I Electric Cooperative, Inc.

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ABSTRACT

This study investigated the present opportunities and challenges about the financial impact of the operation and implementation of the Net-metering program on the Mexico area branch office of (Pampanga I Electric Cooperative, Inc.) PELCO 1, derived from the quantitative and qualitative data from responses of the involved participants. The key themes identified include technological advances in billing and monitoring, cooperative sustainability with solar adoption, clearer regulations and sanctions, negative balances and potential financial risks, adherence to standards and safety protocols, proper information flow, and importance of proactive guidance from PELCO 1. Participants expressed firm preference for integrated modern mechanisms into the Net-metering program, effective transition of energy models, establishing consumer engagement and discretion, proactive financial management, and commercial arrangements. The findings emphasized the financial liability PELCO 1 faces due to its Net-metered consumers, and the notable regulatory and operational gaps of the program. This study provided viable recommendations aimed to safeguard the utility against advancements of the program while promoting balanced compliance with policy requirements. By addressing these identified challenges PELCO 1 could significantly enhance its adoption of the Net-metering program and acquire a refined financial framework. Ensuring the implementation of the program together with the credibility of PELCO 1.

Keywords: Clearer regulations and sanctions; Consumers; Energy models; Negative balances; Net-metering program; Potential financial risks; Proper Information flow; Technological advances; Standards; Sustainability.

1. Introduction

This section provides an overview of the study, and establishes a premise to learn how net-metering programs impact the Mexico Area Branch Office of Pampanga I Electric Cooperative, Inc. (PELCO 1).

1.1. Background of the Study

The Philippine electricity prices are considered as high-cost due to the different factors of processes in providing electricity to the consumers. Mainly, the generation charge that is accounted for by the power generation plants. Ravago [1] emphasized the electricity prices in the Philippines being the highest in the ASEAN region, topping the residential rates in 2021 and industrial rates in 2019, overtaking countries like Thailand, Indonesia, and Malaysia. In response to these challenges, the community in the province of Pampanga has shown openness to integrating alternative sources of electricity. In meeting this demand, the Pampanga I Electric Cooperative, Inc. (PELCO 1) has implemented the use of Net-metering program, enabling consumers to actively participate in energy contribution and in reduction of their electricity bills.

The program enables qualified end-users (QE) to contribute the over generated energy of the owned Renewable Energy (RE) system to the grid of the utility, which then converted into credits used in reducing the electricity expenditure of the QE. Dietrich [2] explained that the excess generated power from the photovoltaic installation is delivered to the local distribution grid and used to offset the electricity dues of the user, now they are able to save up on their account and they can protect themselves from rising electricity prices.

Within this framework, the Municipality of Mexico, which is served by the Mexico-Sta. Ana area office has been identified as the primary area of interest due to the noticeable population of QE in the area. The recurring phenomenon of consumers only installing solar photovoltaic (PV) systems for the sake of generating excess energy to compensate for their outstanding balance remained as a problem for the management of PELCO 1. According to Korcaj, Hahnel, and Spada [3] the attitude towards the adoption of PV systems was driven by the aspirations about social status, autarky, and financial gains. While these developments promote consumer welfare, they also present expected impacts on the Distribution Utility (DU), influencing its financial framework. These effects have been categorized as both opportunities and challenges in the operation of the utility under the net-metering program.

1.2. Statement of the Problem

The adoption of the Net-metering program exhibits an opportunity for renewable generation and the contribution of the excess energy to the grid in exchange for offset of electric billing. In accordance with the Department Circular No. DC2024-08-0025 [4] of the Department of Energy which tackles furthering of policies to enhance the net-metering program and its amendments as contrary to the DC2020-10-0022 [5]. Therefore, as amended in Section 6, indicates that the earned credits of the qualified end-users continue to add up to the existing owed balance of PELCO 1 monthly, without year-end forfeiture.

Therefore, this study aimed to address the following problems

1. What is the level of Regular consumers' awareness in Net-metering program?
2. What is the level of Net-metered consumers' experience in Net-metering program?
3. What are the operational and financial implications of net-metering adoption for PELCO 1's Mexico Area Branch?
4. What key operational and regulatory challenges affect the implementation of the net-metering program in PELCO 1's Mexico Area Branch based on consumer energy data and billing records from January to December 2024?
5. What are the potential financial risks of the current Net-metering policies on PELCO 1 - Mexico Area Branch?

1.3. Objective of the Study

Satchwell, Mills, and Barbose [6] emphasized that the potential to make developments and decisions on issues like energy policy regarding financial impacts has been hindered because of data insufficiency on both the distribution utilities and its consumers, and the instances these implications could fluctuate in consideration of the constant change in energy demand, adjustment on policies or market condition. Therefore, the absence of evidence complicates the assessment and dilemma in making informed decisions that could manage potential financial constraints. In line with these, the study aims to assess the net-metering program in its technical processes to meet the desired outcome it implies on the financial aspect of Mexico's service area. The specific objectives of the study were:

1. Identify the level of awareness of the Regular consumers regarding Net-metering program.

2. Identify the level of experience of the Net-metered consumers regarding the Net-metering program.
3. Assess the operational and financial implications of Net-metering adoption in the Mexico Area Branch of PELCO 1.
4. Identify the operational and regulatory challenges associated with the net-metering program in the Mexico Area Branch of PELCO 1 by examining consumer energy import-export patterns, billing deductions, and REC data from January to December 2024.
5. Assess financial effects of the net-metering program on departmental operations and provide policy recommendations about the program that enhances the economic viability and strategic adaptation of the cooperative in the Mexico Area of PELCO 1.

2. Methods

This research employed a mixed method of methodology to investigate the financial effects of the net-metering program at Mexico Service Area Office of Pampanga I Electric Cooperative, Inc. (PELCO 1). It introduced research design, which combined both quantitative and qualitative methods to provide comprehensive analysis.

2.1. Conceptual Framework

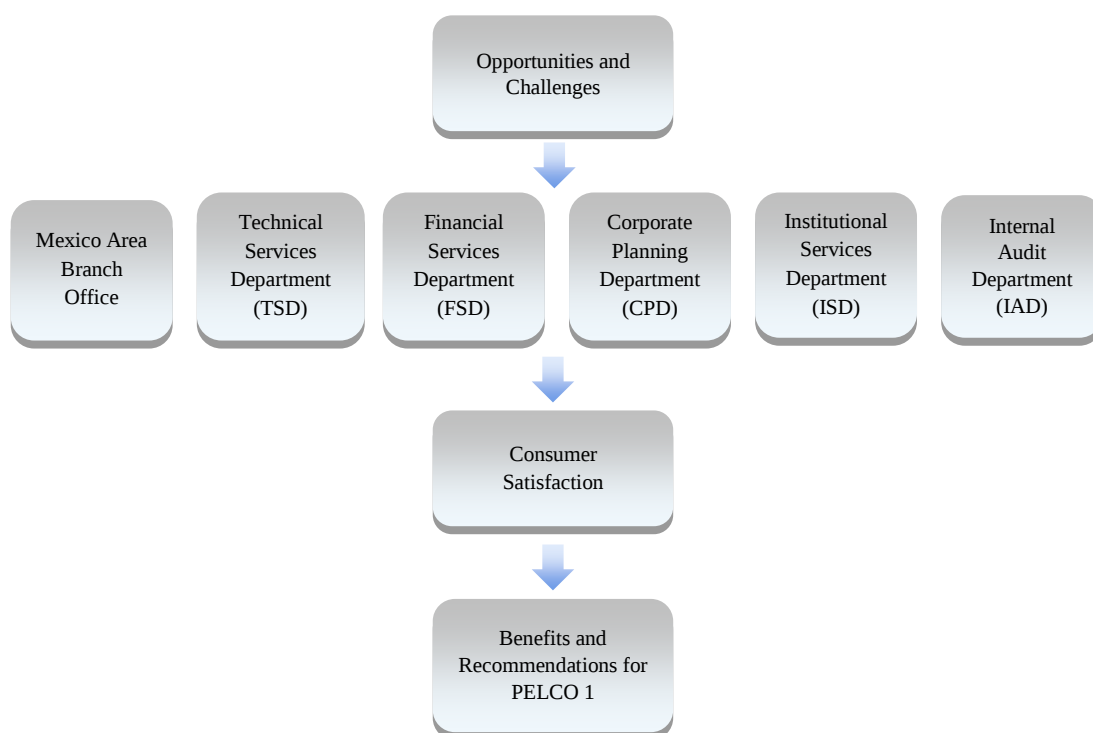


Figure 1. Conceptual Framework

The conceptual framework of the study offered a systematic method of identifying key opportunities and challenges concerning the Net-metering program. Six departments at PELCO 1 were selected due to their involvement in implementation and management of net-metering. Convenience sampling was used, and experienced personnel from these departments participated in semi-structured interviews to contribute operational and financial insights.

At the same time, consumers' views were gathered through survey questionnaires administered to 30 respondents, including 15 net-metered consumers and 15 ordinary consumers, on four point likert scale. Survey assessed consumer awareness, satisfaction, and perceived impact of the net-metering program. The quantitative data gathered from these responses helped to validate the qualitative findings from staff interviews.

2.2. Research Design

This research utilized a mixed-method analysis to evaluate the financial effects of the net-metering system on the Mexico Area Branch Office of PELCO 1. This approach combined both quantitative and qualitative techniques to comprehensively analyze the technical, operational and economic data critical for assessing and obtaining the study's objectives. The qualitative component of the study requested interviews with personnel of the Main office and Mexico-Sta. Ana Area Office of PELCO 1 to identify operational challenges, benefits, and general perceptions of the program. The quantitative component of the study focused on both regular and net-metered consumer responses by utilizing survey questionnaires.

2.3. Research Locale

The research study was conducted in the Mexico-Sta. Ana Area Branch Office of Pampanga 1 Electric Cooperative (PELCO 1).

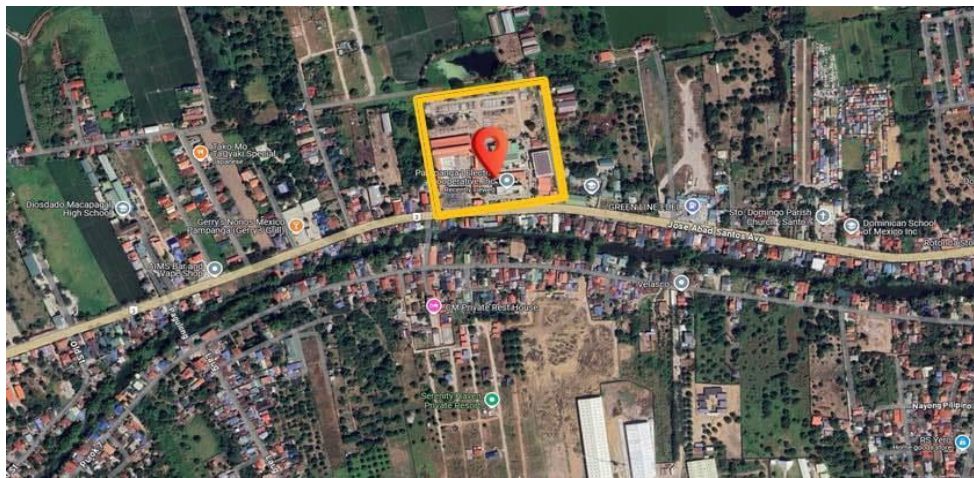


Figure 2. Mexico-Sta Ana Area Branch Office

2.3.1. Respondents

For the quantitative part of the study, the researchers employed a convenience sampling method in choosing 15 regular consumers and 15 net-metered consumers of PELCO 1 as respondents for the survey. For the qualitative phase of the study, the participants included key staff members from various departments within PELCO 1. Using the Convenience Sampling method, two (2) staff from each of the specified departments underwent an interview designed for thematic analysis.

The PELCO 1 departments considered for the interview were the following:

- a. Mexico-Sta Ana Area Office
- b. Technical Services Department (TSD)

- c. Financial Services Department (FSD)
- d. Corporate Planning Department (CPD)
- e. Institutional Services Department (ISD)
- f. Internal Audit Department (IAD)

2.3.2. Inclusion Criteria

The respondents for the interview and survey were considered using the following inclusion criteria:

1. PELCO 1 Staff
2. Staff shall be under the specific departments outlined.
3. Regular and net-metered consumers under the PELCO 1 Mexico Service Area.

Table 1. Respondents for Interview and Survey

Key Informants	Sampling Methods	Respondents	Sample Size
Respondents	Convenience	Regular Consumers	15
		Net-metered Consumers	15
Participants	Convenience	PELCO 1 Staff Experts	12
Total			42

Table 2. Quantitative Interview Participants

Participants	Department	No. of Participants	Research Problem
PELCO 1 Key Staff	Regular Consumers	15	SOP 1
	Net-Metered Consumers	15	SOP 2
Total		30	

Table 3. Qualitative Interview Participants

Participants	Department	No. of Participants	Research Problem
PELCO 1 Key Staff	Mexico-Sta Ana Area Office	2	SOP 3
	Technical Services Department (TSD)	2	SOP 4
	Financial Services Department (FSD)	2	SOP 5
	Corporate Planning Department (CPD)	2	SOP 4
	Institutional Services Department (ISD)	2	SOP 5
	Internal Audit Department (IAD)	2	SOP 5
Total		12	

2.4. Instrumentation

The study used the combination of structured surveys as well as semi-structured interviews. For the quantitative data, two survey instruments were developed.

1. For Regular consumers: evaluating comprehension, engagement, and perceived influence.
2. For Net-metered customers: evaluation of the application process, financial benefit, and overall Experience.

Both questionnaires used a four-point Likert scale with answers from "poor" to "very good" or from "strongly disagree." to "strongly agree" as appropriate. The qualitative tool was a structured interview schedule with open-ended questions that were designed to address specific themes by department. These questions were based on proven operating and financial indicators relevant to net-metering.

2.4.1. Interview Guide

In this study, thematic analysis was employed to analyze the qualitative data gathered through interviews with key staff at PELCO 1. These were the concepts connected to the net-metering that was used as basis for the interview to be conducted with the key departments of PELCO 1 focusing on financial impact of the net-metering program:

(1) For Participants 1 & 2: Mexico-Sta. Ana Area Office

- Negative Electric Balance
- Improper Use of Solar PV Systems
- Policy Recommendations
- Preparedness for Growth
- Infrastructure Challenges

(2) For Participants 3 to 6: Technical Services Department (TSD) and Corporate Planning Department (CPD)

- Permit and Approval Process of QE's
- Inspection Process and Compliance
- Compliance and System Standards
- Technical Inefficiencies and Risks
- Financial Risk Mitigation
- Opportunities and Strategic Growth (CPD)
- Long-Term Implications (CPD)

(3) For Participants 7 & 8: Financial Services Department (FSD)

- Financial Challenges regarding Net-Metering Program

- Strategies to Address Financial Effects
- Regulation and Impact of Energy Import and Export
- Grid Stability and Maintenance
- Demand-Supply Alignment
- Financial Opportunities of Net Metering
- For Participants 9 & 10: Institutional Services Department (ISD):
- Contract Notarization of QE's and PV Contractors
- Monitoring Consumption Patterns
- Contract Violation
- Policy Proposals

(4) For Participants 11 & 12: Internal Audit Department (IAD)

- Revenue and Expense Discrepancies regarding Net-Metering Program
- Energy Export and Financial Report
- Audit Challenges regarding Net-Metering Program

These topics helped identify recurring themes, which were critical for conducting thematic analysis necessary in meeting the study's objectives.

2.4.2. Thematic Analysis

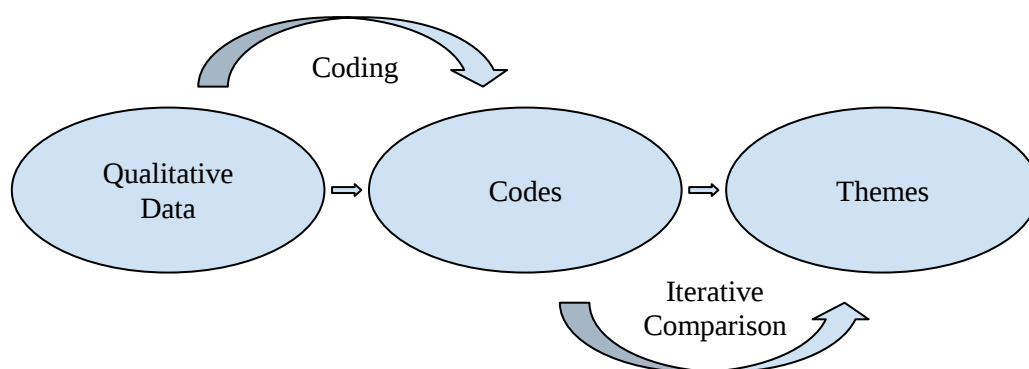


Figure 3. Thematic Analysis

In order to analyze certain patterns or themes of the gathered data, thematic analysis is the best suit for the qualitative research methodology Braun & Clarke [7]. The analysis started by identifying codes or patterns within the qualitative data. An iterative comparison was then conducted to determine reappearing and underlying themes. This analysis was essential in interpreting the qualitative data collected from the interviews and finding themes that determine the financial effects of net-metering in the Mexico service area of PELCO 1. Additional secondary data were obtained from PELCO 1 records for the year 2024. These included: Monthly kWh sales, Net-metered

consumer energy exports and financial transactions, Monthly electricity rates and annual average. This data was subjected to cost estimation and sensitivity analysis to further evaluate the program's financial implications for the utility provider.

3. Results and Discussion

This section presents the findings and implications of the study regarding the net-metering program of PELCO 1 in the Mexico service area office. Results and discussions are presented in alignment with each research problem.

3.1. Quantitative Interpretation

3.1.1. What is the level of Regular consumers' awareness in Net-metering program?

Table 4. Awareness of Net-Metering Program

Indicators	Mean	SD	Interpretation
1. How well are you informed about the net-metering program offered by PELCO 1?	2.13	0.99	Fair
2. To what extent do you understand how the net-metering program operates?	2.20	0.94	Fair
3. How aware are you of the benefits associated with the net-metering program?	2.13	0.99	Fair
4. How effective has PELCO 1 been in promoting awareness of the net-metering program to its customers?	1.87	1.06	Fair
General Mean Average	2.08	1.00	Fair

In Table 4, results indicate low levels of consumer awareness about the program, with a general mean of **2.08** ("Fair"). Consumers showed limited understanding of the program's operations (mean: **2.20**), benefits (**2.13**), and technical aspects such as billing and installation. The lowest score (**1.87**) reflected poor perception of PELCO 1's effectiveness in promoting the program.

Table 5. Interest in Net-Metering Program

Indicators	MEAN	SD	Interpretation
5. How satisfied are you with the reliability of PELCO 1's electric service?	3.20	0.56	Good
6. How interested are you in learning more about the net-metering program?	3.27	0.59	Good
7. Do you think the cost of buying solar panels for net-metering is worth it in the long run?	2.93	0.88	Good
8. How likely are you to consider enrolling in the net-metering program if given the opportunity?	3.07	0.70	Good
General Mean Average	3.12	0.69	Good

In Table 5, consumers showed a good level of interest in PELCO 1's net-metering program (mean: **3.12**). They expressed strong interest in learning more (**3.27**) and rated service reliability positively (**3.20**). Willingness to enroll scored **3.07**, while the perceived value of solar investment was slightly lower (**2.93**), likely due to financial concerns.

Table 6. Perceived Impact of Net-Metering Program

Indicators	Mean	SD	Interpretation
9. The cost of transitioning to a net-metering system is expensive.	2.80	0.94	Good
10. The net-metering program could help reduce electricity costs for households.	3.27	0.70	Good
11. The net-metering program encourages the adoption of renewable energy in the community.	3.20	0.77	Good
12. The net-metering program has a positive impact on the environment.	3.27	0.70	Good
General Mean Average	3.21	0.96	Good

In Table 6, consumers perceived the net-metering program positively (mean: **3.21**). Highest ratings were for environmental benefits (**3.27**) and reduced electricity costs (**3.27**), with renewable energy promotion also rated well (**3.20**). Initial cost concerns were noted (mean: **2.80**), but overall support suggests potential for increased adoption with better financial and educational support.

3.1.2. What is the level of Net-metered consumers' experience in Net-metering program?

Table 7. Application for the Net-Metering Program

Indicators	Mean	SD	Interpretation
1. How easy did you find the process of applying for the net-metering program?	3.73	0.46	Very Good
2. How straightforward did you find the process of submitting documents for the application?	3.73	0.46	Very Good
3. How reasonable is the amount of time it takes to complete the application process for net-metering?	3.60	0.63	Very Good
4. How does PELCO 1 provide sufficient technical support during the installation phase?	3.60	0.83	Very Good
General Mean Average	3.57	0.78	Very Good

In Table 7, net-metered consumers reported a very good experience with the application aspect of the program (mean: **3.57**). High ratings were given for ease of application (**3.73**), clarity of document submission (**3.73**), reasonable timeline (**3.60**), and technical support (**3.60**).

Table 8. Financial Assessment of the Net-Metering Program

Indicators	Mean	SD	Interpretation
5. How well do you understand how your energy exports and imports are calculated in your billing?	3.60	0.63	Very Good
6. How much have your electricity bills decreased since enrolling in the net-metering program?	3.53	0.64	Very Good
7. How well do the financial savings from net-metering meet your expectations?	3.53	0.64	Very Good
8. How reasonable were the upfront costs of installing solar panels considering the benefits?	3.47	0.64	Very Good
9. How clearly and correctly does PELCO 1 process your exported electricity credits?	3.67	0.62	Very Good
10. How fair is the billing process for net-metering for participating consumers?	3.73	0.46	Very Good
General Mean Average	3.58	0.65	Very Good

In Table 8, net-metered consumers assessed the program as very good (mean: **3.58**). High scores were given for billing clarity (**3.73**), credit processing (**3.67**), and understanding of energy calculations (**3.60**). Consumers also noted expected savings (**3.53**), reduced bills (**3.53**), and reasonable installation costs (**3.47**).

Table 9. Experience with Net-Metering Program

Indicators	Mean	SD	Interpretation
11. How is your overall experience with the net-metering program?	3.73	0.59	Very Good
12. How would you rate your experience with technical issues in your net-metering system?	3.53	0.92	Very Good
13. How would you rate the timeliness of PELCO 1's support in resolving net-metering issues?	3.60	0.83	Very Good
14. How manageable has the maintenance of your solar panels or system been?	3.60	0.63	Very Good
15. How fair do you think the current net-metering policy is to consumers?	3.73	0.59	Very Good
16. How satisfied are you with the net-metering program by PELCO 1?	3.67	0.62	Very Good
General Mean Average	4.08	0.73	Very Good

In Table 9, net-metered consumers reported a very good overall experience with the program (mean: **4.08**). High ratings were given for fairness of policy and overall experience (**3.73**), program satisfaction (**3.67**), technical support timeliness (**3.60**), system maintenance (**3.60**), and issue handling (**3.53**).

3.2. Qualitative Interpretation

3.2.1. What are the operational and financial implications of net-metering adoption for PELCO 1's Mexico Area Branch?

The financial and operation impacts related to the implementation of net metering at PELCO 1's Mexico Area Branch revealed several interconnected themes.

First, oversized solar installations were commonly reported, with several consumers recorded to have generated large quantities of excess energy, contributing to negative balances which serve as a liability to the utility. The participants ask for proper sizing of PV systems based on actual household consumption. Second, the participants reported growing do-it-yourself (DIY) solar installation activity, driven by online sites and marked by the lack of coordinated effort with utilities. The unregulated installations are hazardous and hinder effective grid integration, particularly in the absence of contracts or non-compliance penalties. Participants cited significant regulatory gaps, and reported a lack of measures for enforcement and more specific guidance. Without penalties under the law for illegal systems, the fairness and efficiency of the net-metering program are undermined. Consumer awareness is also a key theme. Ineffective dissemination of information, particularly on system constraints and policy needs, prevents informed participation. The participants recommended that PELCO 1 enhance communication through the use of digital media and proactive outreach. In spite of these challenges, the respondents welcomed the cooperative's technological innovation, especially in the transparency of billing and remote monitoring via mobile apps. They have improved consumer involvement and organizational efficiency. Finally, there has been concern for the long-term financial sustainability of the cooperative. The more people generate their own electricity, the more

the traditional revenue model is put in jeopardy. Without alternative pricing models or hybrid approaches, PELCO 1 is facing financial instability.

3.2.2. What key technical and regulatory opportunities and challenges affect the implementation of the net-metering program in PELCO 1's Mexico Area Branch based on consumer energy data and billing records from January to December 2024?

These were the following themes that were derived from the responses of four participants from the Technical Services Department (TSD) and the Corporate Planning Department (CPD).

The functioning of the net-metering program in PELCO 1's Mexico Area Branch revealed technical capacities and regulatory challenges on its operational success. The participants emphasized the important role played by the Technical Services Department (TSD) of PELCO 1 in inspecting photovoltaic (PV) installations, ensuring interconnection standards, and ensuring legality and utility compliance. This is as stipulated by DOE and ERC regulations to achieve safe and efficient grid integration. Several challenges were cited, however. The participants cited recurrent mismatches between consumer demand and the capacity of the solar system, a lot of which result in energy imbalances and economic losses. Oversized installations not only strain the grid but also exemplify the absence of technical management in planning and installation processes. The absence of standardized procedures and obligatory sanctions against non-compliant or DIY installations was considered an impediment to effective implementation. Ineffective dissemination of guidelines also cripples consumer compliance and limits the program's scope. Participants also used the term knowledge gap in consumer awareness and dissemination of information. Consumers lack easy access to timely information and advice on net-metering policies, system size, and billing systems. Respondents suggested that PELCO 1 increase communication through social media and online platforms. Despite such challenges, there was room for improvement. PELCO 1 has begun integrating mobile technologies to enhance billing openness and power management, allowing consumers to track consumption and fees through online resources. The participants identified such efforts as steps in the direction of enhanced program administration and consumer engagement.

3.2.3. What are the potential financial risks of the current Net-metering policies on PELCO 1 - Mexico service area?

Table 10. Monthly Sales of kWh for Consumers Under Net-Metering in the Mexico Area Branch Office of PELCO 1 for the year 2024

Month	REC kWh (Generated)	kWh Exported (kWh)	Amount Deducted (Php)	kWh Used	Total Amount (Php)
January	106,548	20,145	(121,726.87)	129,029	1,125,727.98
February	95,828	154,181	(1,268,910.81)	116,553	791,079.90
March	111,040	33,061	(152,721.65)	162,109	1,404,077.33
April	141,340	66,638	(227,935.29)	186,500	1,086,794.40
May	157,963	66,556	(378,196.39)	243,585	2,008,213.57

June	133,189	58,705	(249,602.50)	211,177	1,530,138.35
July	125,141	56,244	(340,437.90)	195,821	1,625,733.51
August	147,187	73,278	(482,714.05)	270,698	2,591,341.09
September	117,685	52,477	(371,655.50)	215,711	2,220,671.02
October	132,168	60,418	(352,124.51)	210,465	1,787,737.49
November	140,710	64,167	(350,973.15)	219,426	1,963,551.73
December	119,889	53,857	(301,083.59)	212,896	1,894,685.46
Total	1,528,688	759,727	4,598,082	2,373,970	20,029,752

The Mexico Area Branch Office of PELCO 1 in 2024, among Net-metered consumers, generated 1,528,688 REC kWh. The REC kWh is the total energy generated by the RE system, while the kWh exported is the surplus energy exported by the net-metered consumer to the utility's grid, which in 2024 would be a total of 759,727 kWh. The amount in Php of the energy exported is labelled as the amount deducted. The total amount deducted due to exports was approximately ₱4.6 million. The kWh used is the imported energy of net-metered consumers from the PELCO 1, and its corresponding amount is labelled as the "Total Amount". The "Total Amount" is the total sales of the energy usage from the imported energy of net-metered consumers from PELCO 1. This amount is not the total revenue of the utility from the sales of exported energy. The total sales from electricity usage (import) in 2024 was about ₱20 million. These figures suggested a dynamic energy profile that included both energy generation and export, likely from renewable sources given the REC designation, and significant internal energy used across the year. Hence, the net-metered consumers' monthly Generated kWh (column 2) and Exported kWh (column 3); hence, the Net-metered consumers' kWh consumption from solar energy (referred by the utility as "own use") can be computed by:

$$kWh \text{ Consumption from RE system} = REC \text{ kWh (generated)} - kWh \text{ (exported)} \quad \dots(1)$$

For this instance, for the year 2024, the Net-metered consumers have used 768, 961 kWh out of their own generated kWh which PELCO 1 – through its finance head – considered this consumption as losses in their annual sales of kWh. Because of net-metering, there exists two sources of energy where consumers can rely on: the Generated kWh from the RE system and import energy from PELCO 1. Net-metered consumers rely on solar while it harvests energy (mostly during the day), and get energy from the grid of PELCO 1 when solar PV systems stop from producing energy or if RE generation is insufficient to provide the load demand. The energy generated by the RE system and used by the net-metered consumer (referred by PELCO 1 as "own use") is not included or registered in the computation of DSM (Distribution System Metering) RSSC charges, which is considered as the utility's revenue. The "own use" energy is also not included in the computation of DSL (Distribution System Loss). In other words, the "own use" energy is considered by the utility as a loss since this energy is supposed to be PELCO 1's sales. Also, negative balances are considered as a liability by the distribution utility. These balances are audited by PELCO as "Consumer Advances Fee – Net Metering (CAF-NM)". Currently, these balances are not remittable by the consumers, the utility pointed out however, that the balances can be remitted by the consumer once the ERC orders the utility to do so. In theory, the value of REC kWh (generation) should be higher than the export energy,

There was however, noticeable discrepancies wherein the exported energy is higher than the REC kWh (e.g. February 2024 export energy and REC kWh). PELCO 1 recognizes these instances as errors in meter reading. The utility reiterates that the values acquired in the original reading are still recorded despite the noticeable discrepancies as per ERC guidelines. Export energy shares the same label as a generation entity as WESM. And its accumulated Peso equivalents (monthly) is additive in the computation of monthly total generation charges of PELCO 1 which can be solved by adding all the charges from all the generation companies where the DU had contracted with, and in this case, Export energy from RE system is included in the equation.

In terms of Peso:

PELCO 1 Monthly Generation Charges =

$$WESM + BacMan + Export Energy (RE) + \dots + Other generation companies \quad \dots(2)$$

To compute for PELCO 1's Monthly Generation Rate, the eq. 2 serves as the dividend; hence, other entities in the equation such as figures in the divisor are not anymore part of the scope of the study as stated in the scope and limitation of the study. In conclusion, PELCO 1 considers monthly export energy from RE systems as "pass through charges" as it is directly (without any other charges) convertible into peso by multiplying it with the generation rate for the month it is read. The DU is mandated to transform it to peso credits, however, these credits will still be returned to the DU the same amount the net-metered consumers were paid off. In simple terms, the DU gains nothing from the export energy.

The following themes derived from the responses of six participants from the Financial Services Department (FSD), Internal Audit Department (ISD), and Institutional Services Department (ISD).

Participants emphasized the critical role of inspection and compliance with the established utility standards. The participants highlighted that the Technical Services Department (TSD) conducts on-site inspections to ensure installation complies with local regulatory and safety regulations. Financial risks of net-metering were also identified. Several respondents mentioned the rising issue of negative balances, wherein consumers' exports of energy exceed their consumption levels, necessitating financial liabilities for the cooperative. These continuous credit balances are treated internally as arrears to consumers and are a long-term risk for the cash flow of cooperatives. Participants noted that contract management processes follow established internal procedures, including initial review and approval by relevant departments, and adherence to ISO standards. These practices ensure that documents are properly reviewed and maintained in compliance with regulatory mandates, minimizing the risk of policy violations.

Internal audit procedures were also identified as a key theme. Participants indicated that site random inspections are conducted monthly to verify the operation of installed systems and to ensure accuracy in billing. Common routine issues such as malfunctioning meters or improper installations were identified as causes of billing discrepancies. Re-reads however, are conducted at the sites and technical verifications are done after locating discrepancies. At the policy level, institutional compliance with national regulations was emphasized. Respondents affirmed that PELCO 1 aligns its practices with ERC guidelines and NEA requirements. No formal complaints regarding contract

violations had been recorded, and the cooperative continues to observe regulatory protocols to ensure policy alignment. Lastly, financial benefits to consumers were acknowledged, especially the advantage of maintaining negative electric bills through solar energy exports. Participants stressed, however, the importance of keeping PV installations within the allowable capacity limits to prevent grid instability. Properly sized systems were seen as essential to realizing the financial advantages of net-metering without compromising cooperative operations.

4. Conclusion

This section presents the important insights in the study as it explains the implications of the study based on the results. It also gives specific actions without regard to policy, practice, theory, and future research.

The net-metering program projects strong potential for opportunities but is hindered by challenges in terms of awareness, policy, and financial regulatory planning. While most regular consumers were initially unaware of the program due to lack of promotion, still, many expressed strong interest once informed—driven by its potential to lower electricity costs, environmental benefits, and support for renewable energy. On the other hand, existing net-metered consumers reported high satisfaction, especially with the program's accessibility, technical support, financial gain and transparency. However, these positive consumer experiences contrast with the program's underlying challenges. Implementation has been hampered by mismatched solar PV system sizing, unclear and inconsistent regulations, and weak coordination among stakeholders. In addition, outdated billing, monitoring, and communication systems undermine the program's operational efficiency. These issues also carry financial risks for PELCO 1, including liabilities for both the excess energy and negative balances, and most of all: the revenue shortfalls for the utility. In line with these, strategic intervention over these risks should be realized as to not experience the eventual jeopardization of both the utility's financial standing and the long-term sustainability of the program. To move forward, the demand for clear policy reforms, improved infrastructure, enhanced stakeholder coordination, and proactive consumer education should be addressed by the utility itself as well as by proper government agencies because if these challenges are addressed, holistically will ensure the net-metering program remains and will continue to benefit the consumers while safeguarding the operational and financial stability of the utility.

5. Future Suggestions

Based on the constructed findings and conclusion, these are the following suggested recommendations given:

1. PELCO 1 should implement stricter compliance with comprehensive guidelines regarding the selection process of solar PV systems that are compatible with the Qualified End-user's (QE) ideal power consumption. Clearly stating the appropriate sizes and modification of solar installations based on the consumer's electricity demand and the utility may consider setting minimum kW capacity based on the load profile of the net-metering applicant to reduce instances of negative balances.
2. PELCO 1 may consider investing in Advanced Metering Infrastructure (AMI) or any real-time net-metering monitoring system to enhance its billing and monitoring capabilities. The utility may also conduct regular observations and analysis of the metering data from all active net-metered consumers.

3. PELCO 1 may provide sufficient assistance through widespread information dissemination to its covered consumers regarding the net-metering program. It should include important details to help consumers make well-informed decisions about the program.
4. PELCO 1 may establish a clear system for the termination of net-metered accounts. Currently, the utility is compelled to postpone billing for consumers with decommissioned PV systems due to discrepancies in billing classification.
5. PELCO 1 may conduct a strategic evaluation of the program's future possibilities, considering the increasing number of Qualified End-users (QEs) and the growing instances of negative balances associated with them. This evaluation may also include the integration of potential modernized solutions to ensure the long-term sustainability of the cooperative within the eco-friendly energy sector.

Declarations

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Competing Interests Statement

The authors declare that they have no competing interests related to this work.

Consent for publication

The authors declare that they consented to the publication of this study.

Authors' contributions

EIN and ECM carried out the overall planning and supervision of the work and contributed equally to the writing of the paper. CSE performed formal analysis, editing and revising of the manuscript. All the authors approved the final copy of the manuscript.

Availability of data and materials

Authors are willing to share data and material on request.

Institutional Review Board Statement

This study was approved by the Institutional Review Board of Don Honorio Ventura State University, Philippines.

Informed Consent

All participants in this study voluntarily gave their informed consent prior to their involvement in the study.

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